Aqua MODIS Thermal Emissive Band On-Orbit Calibration, Characterization, and Performance

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Abstract—**The NASA's Earth Observing System Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) has continued to operate with satisfactory performance since its launch in May 2002, exceeding its nominal six-year design lifetime. Its continuous Earth observations have been used to generate many science data products for studies of the Earth's system. MODIS has 36 spectral bands: 20 reflective solar bands and 16 thermal emissive bands (TEBs). All TEB observations are made at 1-km nadir spatial resolution with spectral wavelengths from 3.7 to 14.4 μm. Primary applications of MODIS TEB include surface, cloud, and atmospheric temperatures, water vapor, and cloud top altitude. MODIS TEB on-orbit calibration uses a quadratic algorithm with its calibration coefficients derived using an on-board blackbody (BB). This paper will present Aqua MODIS TEB on-orbit calibration, characterization, and performance over its six-year mission. Examples of instrument thermal behavior, BB temperature stability, detector short-term stability, and changes in long-term response (or system gain) will be presented. Comparisons will also be made with Terra MODIS, launched in December 1999. On-orbit results show that Aqua MODIS and its focal plane temperatures have behaved normally. BB temperature has remained extremely stable with typical scan-to-scan variations of less than $\pm$0.15 mK. Most TEB detectors continue to exceed their specified signal-to-noise ratio requirements, exhibiting excellent short-term stability and calibration accuracy. Excluding a few noisy detectors, either identified prelaunch or occurring postlaunch, on-orbit changes in TEB responses have been less than 0.5% on an annual basis. By comparison, the overall Aqua TEB performance has been better than that of Terra MODIS.**

Index Terms—**Aqua, blackbody (BB), calibration, detector, Moderate Resolution Imaging Spectroradiometer (MODIS), radiometer, thermal emissive bands (TEBs).**